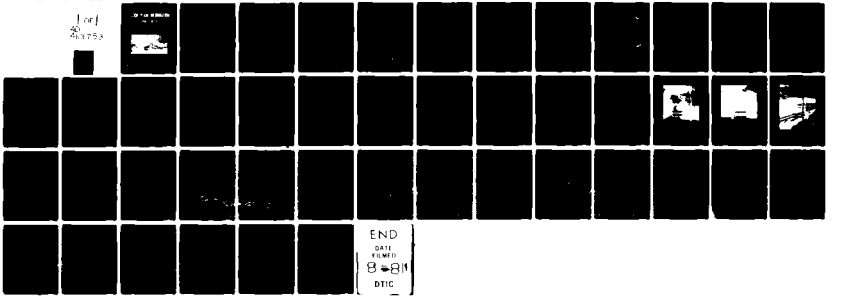
AD-A101 753 ARMY ENGINEER DISTRICT PHILADELPHIA PA F/G 8/8
FLOOD PLAIN INFORMATION, PIKE CREEK, NEW CASTLE COUNTY, DELAWAR--ETC(U)
DEC 75
UNCLASSIFIED DAEN/NAP-82040/FPI35-75/1 NL



FLOOD PLAIN INFORMATION

PIKE CREEK

(1)

NEW CASTLE COUNTY, DELAWARE.

LEVEL II

REPT. NO: DAEN/NAP-82040/FPI35-75/12

PREPARED FOR NEW CASTLE COUNTY DEPARTMENT OF PLANNING BY THE DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT, CORPS OF ENGINEERS, PHILADELPHIA, PA.

"Original contains color plates: All DTIC reproductions will be in black and white"

DECEMBER 1975

FPI PIKE CREEK NEW CASTLE COUNTY DELAWARE MAP

TO THE REQUESTOR:

This Flood Plain Information (FPI) Report was prepared by the Philadelphia District office of the U.S. Army Corps of Engineers, under the continuing authority of the 1960 Flood Control Act, as amended. The report contains valuable background information, discussion of flood characteristics and historical flood data for the study area. The report also presents through tables, profiles, maps and text, the results of engineering studies to determine the possible magnitude and extent of future floods, because knowledge of flood potential and flood hazards is important in land use planning and for management decisions concerning floodplain utilization. These projections of possible flood events and their frequency of occurrence were based on conditions in the study area at the time the report was prepared.

Since the publication of this FPI Report, other engineering studies or reports may have been published for the area. Among these are Flood Insurance Studies prepared by the Federal Insurance Administration of the Federal Emergency Management Agency, Flood Insurance Studies generally provide different types of flood hazard data (including information pertinent to setting flood insurance rates) and different types of floodplain mapping for regulatory purposes and in some cases provide updated technical data based on recent flood events or changes in the study area that may have occurred since the publication of this report.

It is strongly suggested that, where available, Flood Insurance Studies and other sources of flood hazard data be sought out for the additional, and, in some cases, updated flood plain information which they might provide. Should you have any questions concerning the preparation of, or data contained in this FPI Report, please contact:

U.S. Army Corps of Engineers
Philadelphia District
Custom House, 2nd and Chestnut Streets
Philadelphia, PA 19106

ATTN: Flood Plain Mgt. Services Branch, NAPEN-M

Telephone number: (215) 597-4807

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: DAEN/NAP-82040/FPI35-75/12	2. GOVT ACCESSION NO.: AD-A102 753
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Flood plain information, Pike Creek, New Castle County, Delaware	5. TYPE OF REPORT & PERIOD COVERED: Flood plain information
	6. PERFORMING ORG. REPORT NUMBER: DAEN/NAP-82040/FPI35-75/12
7. AUTHOR(s)	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: U.S. Army Engineer District Philadelphia, 2nd & Chestnut Sts., Philadelphia, PA 19106	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Engineer District Philadelphia, 2nd & Chestnut Sts., Philadelphia, PA 19106	12. REPORT DATE: Dec 1975 13. NUMBER OF PAGES: 25
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Pike Creek, Dela.
New Castle County Dept. of Planning
New Castle County, Del.
Floods
Flood forecasting
Flood plains

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report covered the flood situation along Pike Creek from its confluence with White Clay Creek near the town of Choate, Dela. to its headwaters near Southwood, Delaware. A history of flooding along Pike Creek was presented along with special emphasis on possible future floods. Details on the flood plain were given thru the use of maps, photographs, profiles and cross sections.

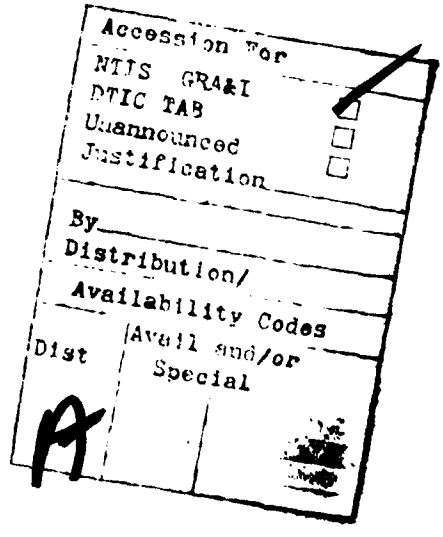
DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Under authority of Section 206 of the 1960 Flood Control Act as amended the flood plain information was prepared by the U.S. Army Corps of Engineers Philadelphia District at the request of the New Castle County Department of Planning. The information should be considered for it historical nature. Since the publication of this FPI report other Flood Insurance studies have been undertaken and should also be consulted for more current information.

NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED FROM THE BEST COPY FURNISHED BY THE SPONSORING AGENCY. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE.



CONTENTS

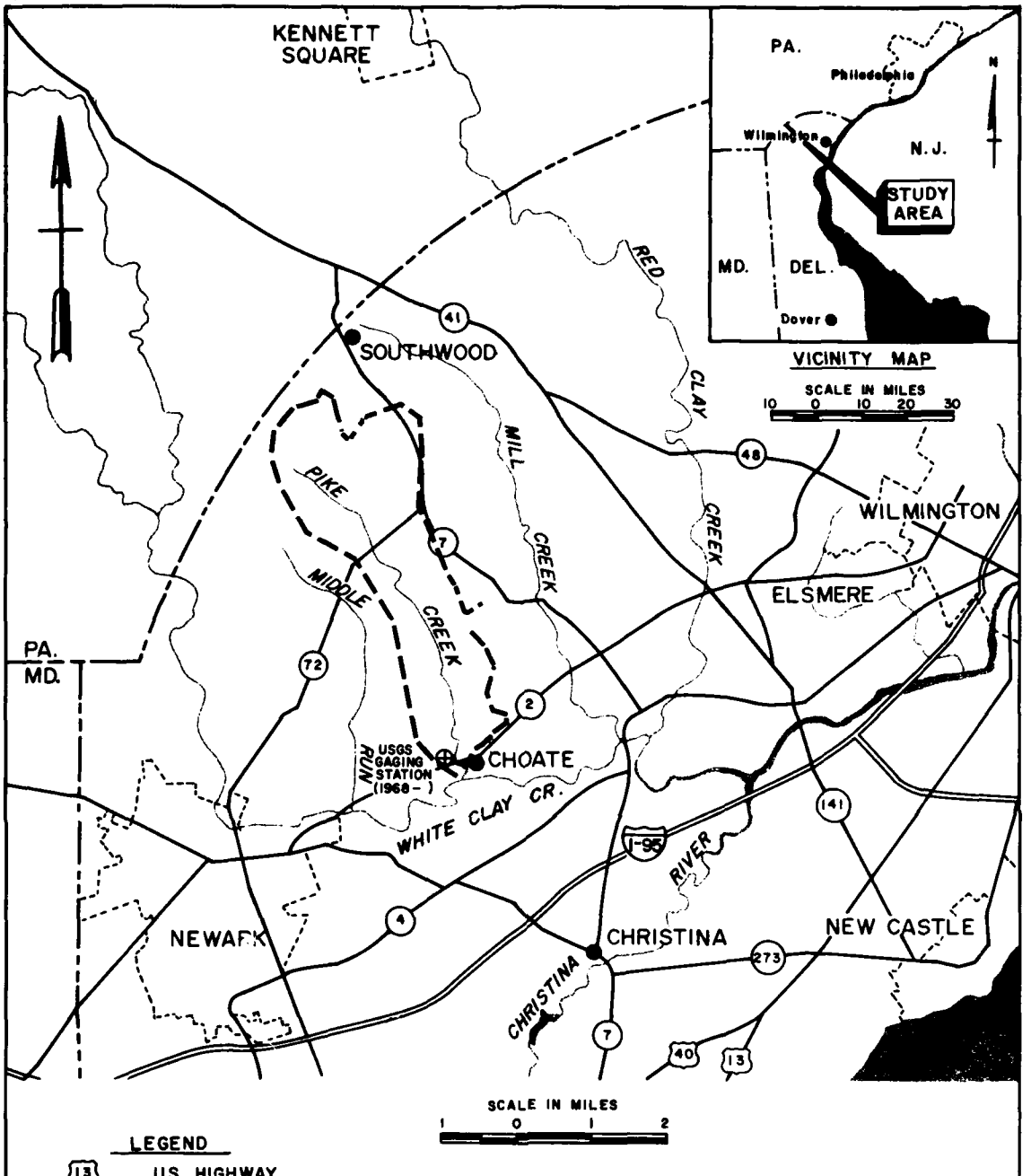
CONTENTS (Continued)

TABLES

CONTENTS (Continued)

PLATES

FIGURES



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

FLOOD PLAIN INFORMATION
PIKE CREEK
NEW CASTLE COUNTY, DEL.

GENERAL MAP

PLATE I

PREFACE

This report covers the flood situation along Pike Creek from its confluence with White Clay Creek near the Town of Choate, Delaware, to its headwaters near Southwood, Delaware. The properties located on the flood plain along Pike Creek are primarily rural with scattered residential and commercial developments, some of which have been severely damaged by past floods. The open spaces in the flood plains which may come under pressure for future development are extensive. Although large floods have occurred in the past, studies indicate that even larger floods are possible.

This report presents information about flood potential and flood hazards because this knowledge is important in land use planning and for management decisions concerning flood plain utilization. It includes a history of flooding along Pike Creek and identifies those areas that are subject to possible future floods. Special emphasis is given to the possible future floods through maps, photographs, profiles and cross sections. The report does not provide solutions to flood problems; however, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevent intensification of the loss problems. It will also aid in the identification of areas where flood damage reduction techniques such as works to modify flooding and adjustments including flood proofing might be embodied in an overall Flood Plain Management (FPM) Program. Other FPM Program studies—those of environmental attributes and the current and future land use role of the flood plain as part of its surroundings—would also profit from this information.

At the request of the New Castle County Department of Planning and indorsement of the Delaware State Department of Highways and Transportation, this report was prepared by the Philadelphia District Office of the U.S. Army Corps of Engineers under the continuing authority provided in Section 206 of the 1960 Flood Control Act, as amended.

Assistance and cooperation of the United States Geological Survey (U.S.G.S.), and the New Castle County Department of Planning in supplying useful data and photographs is appreciated.

Additional copies of this report can be obtained from the New Castle County Department of Planning. The Philadelphia District Office of the Corps of Engineers, Department of the Army, will upon request, provide technical assistance to planning agencies in the interpretation and use of the data presented as well as planning guidance and further assistance, including the development of additional technical information.

BACKGROUND INFORMATION

Settlement

The banks of Pike Creek were first inhabited by the Lenni-Lenape Indians. This tribe dominated the Pike Creek territory until the late 1600's when settlers of Dutch-Swedish origin arrived in the area. The Swedes and Dutch converted the area to farmland and utilized the streams as a source of power. This availability of waterpower from Pike Creek enhanced the construction of mills on Pike Creek and other neighboring streams. The area was later described as having the greatest concentration of mill industries in the colonies. Subsequent transportation and improved highways made it possible to transport farm products to the major trading and shipping towns of Wilmington and Newark.

The depression in the 1930's forced the financial collapse of many mills and the abandonment of mill towns in northern Delaware. However, farming has flourished in the area with the advent of modern agricultural methods and the state's modern highway system which has fostered a recovery of markets. In the future, the Pike Creek Watershed could come under increasing pressure for development as the intense development in and around the Cities of Wilmington and Newark spreads to surrounding suburban areas.

The Stream and Its Valley

Pike Creek, with a total drainage area of 6.3 square miles, is a tributary to White Clay Creek. With its headwaters in northwestern Delaware, Pike Creek flows in a southeasterly direction through New Castle County, Delaware, to its confluence with White Clay Creek near the Town of Choate, Delaware.

The flood plains of Pike Creek along the 6.4 mile study reach covered by this report includes agricultural land, small wooded lots, grassland and scattered residential properties. Throughout the entire length of Pike Creek, the flood plains are generally characterized by steep streambanks covered with brush and trees. In the southern portion of the watershed below Delaware Route 72, the stream slopes an average of 37 feet per mile while in the northern portion the stream slopes an average of 68 feet per mile.

The climate of the study area is characterized by warm, humid summers and damp but not extremely cold winters. Average annual precipitation is 46 inches with the greatest amounts of rainfall generally occurring during July and August and the least amounts occurring in autumn and early winter.

Drainage areas contributing to runoff at locations within the study area are shown in Table 1.

TABLE 1

DRAINAGE AREAS ALONG PIKE CREEK

Location	Mileage Above Mouth	Drainage Area Total sq. mi.
Pike Creek at Mouth	0.00	6.30
Downstream of Henderson Rd.	1.32	5.33
Downstream of Private Rd.	3.02	3.74
Brackenville Rd.	6.35	0.19

Developments in the Flood Plain

Most of the flood plain of Pike Creek is undeveloped. A few scattered residential structures are located in the flood plain along with associated streets, highways and utility lines. The remainder of the flood plain and much of the watershed is open land which will come under increasing pressure for development in the future.

There is one dam located on Pike Creek, however, it has no flood storage capacity and will not significantly affect floodflows.

FLOOD SITUATION

Sources of Data and Records

The U.S. Geological Survey maintains a crest stage stream gaging station on Pike Creek near Newark, Delaware. Since the record of this gage dates only from 1968, other gaging records in the general area were used in determining the possible magnitude of future floods. Gage records analyzed in this study included those for White Clay Creek near Newark, Delaware (installed in 1931); Red Clay Creek near Wooddale, Delaware (installed in 1943); and, Little Mill Creek at Elsmere, Delaware (installed in 1963), in addition to gage records available for Pike Creek.

To supplement the records at the gaging stations, newspaper files, historical documents and records were searched for information concerning past floods. These records yielded considerable knowledge of floods which have occurred on Pike Creek.

Maps prepared for this report were based on U.S. Geological Survey Quadrangle Sheets entitled, "Newark East, Delaware, 1970"; and "Kennett Square, Delaware, 1968." Structural data on bridges, cross sections and culverts were obtained by field surveys performed by Corps of Engineers, Philadelphia District, personnel.

Flood Season and Flood Characteristics

Records of nearby stream gaging stations indicate the primary flood season to be July, August and September–the season of hurricane and thunderstorm activity. Minor floods have occurred during winter when snowmelt has combined with heavy rainfall. During floods, stages can rise from normal heights to extreme flood peaks in a relatively short period of time with high velocities in the stream channel. At Pike Creek's confluence, high stages of flooding on White Clay Creek can cause a backwater condition on Pike Creek. This "backwater effect" would produce flood peaks on Pike Creek with low velocities of flow.

Factors Affecting Flooding and Its Impact

Obstructions to floodflows – Natural obstructions to floodflows include trees, brush and other vegetation growing along the stream banks in floodway areas. Man-made encroachments on or over the streams such as dams, bridges and culverts can also create more extensive flooding than would otherwise occur.

During floods, trees, brush and other vegetation growing in floodways impede floodflows, thus creating backwater and increased flood heights. Trees and other debris may be washed away and carried downstream to collect on bridges and other obstructions to flow. As floodflow increases, masses of debris break loose and a wall of water and debris surges downstream until another obstruction is encountered. Debris may collect against a bridge until the load exceeds the structural capacity and the bridge is destroyed. The limited flow capacity of obstructive bridges or culverts, debris plugs at the culvert mouth or a combination of these factors retard floodflows resulting in flooding upstream, erosion around the culvert entrance and bridge approach embankments and possible damage to the overlying roadbed.

In general, obstructions restrict floodflows and result in overbank flows and unpredictable areas of flooding; destruction of or damage to bridges and culverts; and, an increased velocity of flow immediately downstream. It is impossible to predict the degree or location of the accumulation of debris; therefore, for the purpose of this report, it was necessary, in the development of the flood profiles, to assume that there would be no accumulation of debris to clog any of the bridge or culvert openings.

As previously mentioned, there is one dam located on Pike Creek. This dam has no flood control capacity and will not significantly affect floodflows.

Pike Creek is spanned by seventeen bridges throughout the study area. Pertinent information on those bridges, most of which are obstructive to floodflows, can be found in Table 5.

Flood damage reduction measures – There are no existing or authorized flood control projects on Pike Creek; however, New Castle County has recently passed an ordinance prohibiting the filling in of flood plain areas and construction on flood plain areas. Although this ordinance will not actually reduce flood damages, it could reduce the increasing damages which are associated with flood plain encroachments.

Other factors and their impacts – The impact of flooding along Pike Creek can be affected by the ability of local residents to anticipate and effectively react to a flood emergency. Efficient flood warning and forecasting systems can give homeowners, business and industry valuable time to remove damageable materials from low-lying areas. Although there is little storage of floatable materials on the flood plain of Pike Creek, increased damages to downstream areas could be reduced if floatable materials stored on the flood plain were removed before being carried downstream to block bridge and culvert openings. Implementation of effective flood fighting and emergency evacuation plans can further reduce flood damages and the incidence of personal injury and death once the creek has reached flood stage.

Flood warning and forecasting – The National Oceanic and Atmospheric Administration (NOAA) maintains a year-round surveillance of weather conditions at the Wilmington, Delaware, and Philadelphia, Pennsylvania, airports. Flood warnings and anticipated weather conditions are issued by the National Weather Service to the city officials, radio and television stations, and the local press media for further dissemination to residents of the area.

Flood fighting and emergency evacuation plans – Although there are no formal flood fighting or emergency evacuation plans for the Pike Creek Watershed, provisions for alerting area residents through local communications media and coordination operations for New Castle County are accomplished by the County Civil Defense Office. This Office maintains communications with the State Civil Defense Headquarters and the National Weather Service and establishes a "flood watch" during the earliest stages of a flood threat. Flood fighting evacuation and rescue activities are coordinated on a county-wide basis with local public agencies.

PAST FLOODS

Summary of Historical Floods

Floods causing significant damage in the Pike Creek Watershed are reported to have occurred in 1843, 1950, 1955, 1969 and 1972. Among these, the July 28, 1969, Flood had the highest recorded stage on Pike Creek at the U.S.G.S. Gage near Newark, Delaware.

Flood Records

Information on historical floods in the Pike Creek Watershed was obtained from the stream gaging station operated by the U.S. Geological Survey near Newark, Delaware, since 1968. Supplementary records of floods in other nearby watersheds were obtained from stream gages on Little Mill Creek, White Clay Creek and Red Clay Creek. Table 2 lists estimated annual peak discharges at the U.S.G.S. Gage site on Pike Creek.

TABLE 2

ESTIMATED ANNUAL PEAK DISCHARGES

U.S.G.S. Gaging Station 01478950
Pike Creek near Newark, Delaware

Date	Discharge cubic feet per second
July 7, 1973	1,160
June 22, 1972	942
February 7, 1971	494
April 2, 1970	427
July 28, 1969	2,550

Historical documents and newspaper files were searched and interviews with several residents were conducted to compile information on the flood history of Pike Creek.

Flood Descriptions

Newspaper accounts of flooding on Pike Creek were overshadowed by more serious flooding in other nearby areas of New Castle County. The following are summaries of floods on selected dates in nearby areas of New Castle County and are considered to be representative of flooding within the Pike Creek Watershed.

August 5, 1843 - A general heavy rain started to fall early in the morning with the rainfront extending well beyond the boundaries of New Castle County. This rain saturated the ground to a depth of several inches. Late the same day, heavy clouds were concentrated over the northeastern tip of New Castle County and portions of southeastern Pennsylvania and were accompanied in some areas by violent winds. The heavy rains turned into an intense downpour that lasted several hours. Because of the already-saturated ground, the water in the streams rose rapidly and before long all of the creeks in the County had overflowed their banks. A review of past floods indicates that this flood may have been more severe than any in recent history and much larger than any of the recorded floods today.

July 28, 1969 - Flooding which occurred on July 28, 1969, constituted the highest rise of water recorded at the gage located on Pike Creek. Due to the limited development in the area, very little damage was sustained in the Pike Creek Watershed; however, more extensive damages were suffered in adjacent watersheds. Red Clay Creek was particularly hard hit causing damages to bridges, buildings, recreation parks and industry in the area. Flood heights reached the second highest flood peak recorded at the gage located at Wooddale, Delaware.

June 22, 1972 - Damages from floods in the northeastern United States caused by Tropical Storm "Agnes" caught the national headlines; however, Delaware was one of the more fortunate states, with damages far below those experienced in other areas such as Central Pennsylvania. Although "Agnes" had produced the maximum flood of record on the White Clay Creek, Pike Creek experienced very little damage. The mood of many Delawareans was summed up by this quote from the Newark, Delaware, WEEKLY POST: "Agnes is considered by many to be the worst storm ever to hit the Eastern United States, leaving thousands of dollars worth of damage in her wake. She decided not to make a lengthy stopover in Delaware on her travels northward. For that we are grateful."

FUTURE FLOODS

Floods of the same or larger magnitude as those that have occurred in the past could occur in the future. Larger floods have been experienced in the past on streams with similar geographical and physiographical characteristics as those found in the study area. Similar combinations of rainfall and runoff which caused these floods could occur in the Pike Creek area. Therefore, to determine the flooding potential of the study area, it was necessary to consider storms and floods that have occurred in regions of like topography, watershed cover and physical characteristics. Discussion of the future floods in this report is limited to those that have been designated as the 10-Year, 50-Year, 100-Year and 500-Year Floods. The estimates of the floods presented in this report are based on existing development of the watershed since future changes within the basin cannot be accurately predicted. The 500-Year Flood represents a reasonable upper limit of expected flooding in the study area. The 100-Year Flood may reasonably be expected to occur more frequently although it will not be as severe as the infrequent 500-Year Flood.

10-Year, 50-Year, 100-Year and 500-Year Floods

The 100-Year Flood is defined as one that occurs once in 100 years on the average although it could occur in any year. It has also been defined as the flood that has a 1% chance of occurrence in any year. The 10-Year, 50-Year and 500-Year Floods, which are also included in this report, represent floods which have a 10%, 2% and 0.2% chance of occurrence in any year, respectively.

The peak flows of these floods were calculated using a regional method developed by the Army Corps of Engineers' Hydrologic Engineering Center. This method utilized regionalized parameters developed from statistical analyses of recorded floodflows and basin characteristics from gaged watersheds throughout the Delaware River Basin. Although the method is generally applicable to ungaged areas, the procedure was adopted for use in the Pike Creek Watershed because of the short period of record of the Pike Creek gage. Peak flows thus developed for the 10-Year, 50-Year, 100-Year and 500-Year Floods at selected locations in the study area are shown in Table 3.

TABLE 3

PEAK FLOWS FOR THE 10-YEAR, 50-YEAR, 100-YEAR AND 500-YEAR FLOODS

PIKE CREEK

Location	Mileage Above Mouth	Flood Discharge - cubic feet per second			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
At mouth	---	1,250	2,460	3,120	5,260
Downstream of Del. Rte. 2 (USGS Gage near Newark, Delaware)	0.42	1,200	2,380	3,010	5,140
New Leather Hill Rd.	1.98	1,070	2,100	2,710	4,590
Upstream of Del. Rte. 72	4.39	575	1,130	1,490	2,480
Downstream of Henderson Rd.	6.20	175	340	440	730

Table 4 shows comparisons of flood elevations at the Del. Rte. 2 Bridge over Pike Creek, Delaware, for the 100-Year and the 500-Year Floods with the highest recorded flood, July 28, 1969.

TABLE 4

COMPARISON OF FLOOD ELEVATIONS

U.S.G.S. Gaging Station 01478950
Pike Creek near Newark, Delaware

Flood	Elevation Feet - Mean Sea Level Datum
500-Year	45.3
100-Year	42.7
July 28, 1969	40.1

Frequency

A frequency curve of peak flows was developed by the regional frequency method. The curve presents the frequency of floodflows up to the magnitude of once in 500 years. The curve, which is available upon request, reflects the judgment of engineers who have studied the area and are familiar with the region; however, it must be regarded as approximate and should be used with caution in connection with any planning of flood plain use. Frequencies of floods larger than the 500-Year Flood can be obtained through extrapolation of the curve but it is not practical to assign a frequency to such large flows as their occurrence is so extremely rare.

Hazards of Large Floods

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise and developments in the flood plain. A 100-Year Flood or 500-Year Flood on Pike Creek would result in the inundation of residential and commercial properties in the study area. Deep floodwater flowing at high velocity and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwater 3 or more feet deep and flowing at a velocity of 3 or more feet per second could easily sweep an adult person off his feet, thus creating definite danger of injury or drowning. Rapidly rising and swiftly flowing floodwater may trap persons in homes that may be destroyed, or in vehicles that are ultimately submerged or floated. Waterlines can be ruptured by deposits of debris and the force of floodwaters, thus creating the possibility of contaminated domestic water supplies. Damaged sanitary sewer lines and sewage treatment plants could result in the pollution of floodwaters creating health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire or law enforcement emergencies.

Flooded areas and flood damages — The areas along Pike Creek that would be flooded by the 500-Year Flood are shown on Plate 2 which is also an index map to Plates 3 through 5. Areas that would be flooded by the 100-Year Flood and the 500-Year Flood are shown in detail on Plates 3 through 5. The actual limits of these overflow areas may vary somewhat from those shown on the maps because the 10-foot contour interval and scale of the maps do not permit precise plotting of the flooded area boundaries. The areas that would be flooded by the 100-Year and 500-Year Floods include commercial and residential properties, along with associated streets and roads. Considerable damage to the facilities would occur during a 100-Year Flood. However, due to the wider extent greater depths of flooding, higher velocity flow and longer duration of flooding during a 500-Year Flood, damage would be more severe than during a 100-Year Flood. Plates 6 through 8 show the water surface profiles for the 100-Year and 500-Year Floods. Depth of flow in the channel can be estimated from these illustrations. Cross sections of the flood plain at selected locations, together with the water surface elevation and lateral extent of the 100-Year and the 500-Year Floods are shown on Plate 9.

Obstructions — *During floods, debris collecting on bridges and culverts could* decrease their carrying capacity and cause greater water depths (backwater effect) upstream of these structures. Since the occurrence and amount of debris are indeterminate factors, only the physical characteristics of the structures were considered in preparing profiles of the 100-Year and 500-Year Floods. Similarly, the maps of flooded areas show the backwater effect of obstructive bridges and culverts, but do not reflect increased water surface elevation that could be caused by debris collecting against the structures, or by deposition of silt in the stream channel under structures. As previously indicated, there is one dam within the study area which has no flood control capacities nor will it seriously alter flow characteristics of floodwaters. Of the seventeen bridges crossing the stream in the study area, most of them are obstructive to the 100-Year and 500-Year Floods as illustrated by the high water profiles on Plates 6 through 8. Table 5 shows water surface elevations at these bridges.

TABLE 5

ELEVATION DATA

Bridges Across Pike Creek

Identification	Mileage Above Mouth	Underclearance Elevation	Water Surface Elevation (a)	
			100-Year Flood	500-Year Flood
		Feet - Sea Level Datum	Feet - Sea Level Datum	
Del. Rte. 2	0.42	46.6	41.3	45.3
Pike Creek Rd.	0.78	48.6	54.0	55.9
Henderson Rd.	1.32	69.6	73.6	75.2
New Leather Hill Rd.	1.98	97.7	98.6	102.8
Abandoned Rd.	2.00	98.7	100.1	103.5
Culvert - Golf Course Rd.	2.68	119.0	121.2	122.2
Culvert - Golf Course Rd.	2.87	125.2	126.7	127.5
Private Rd.	3.02	132.9	136.8	138.7
Granville Rd.	3.63	154.7	157.3	159.4
Del. Rte. 72	4.19	178.3	183.0	183.8
North Star Rd.	4.68	210.6	213.6	217.8
Private Rd.	5.27	254.7	261.2	262.0
Private Rd.	5.30	261.8	269.6	270.6
Private Rd.	5.36	263.0	269.7	270.8
Crossan Rd.	5.53	271.9	272.3	272.9
Bridleshire Rd.	5.68	280.7	285.6	286.3
Henderson Rd.	6.35	329.2	330.4(b)	330.9(b)

(a) Upstream side of bridge.
(b) Downstream side of bridge.

Velocities of flow -- Water velocities during floods depend largely on the size and shape of the cross sections, conditions of the stream, and the bed slope, all of which vary on different streams and at different locations on the same stream. During a 100-Year Flood, velocities of main channel flow for selected cross sections in the study area would vary from 4.4 to 11.2 feet per second. It is expected that the velocity of main channel flow during a 500-Year Flood would be slightly higher than during a 100-Year Flood; however, in some cases backwater from restrictive cross sections may result in lower velocities. Overbank flow for the 100-Year Flood in the study area for the same selected cross sections would vary from 2.8 to 4.0 feet per second.

In general, water flowing at 2 feet per second or less would deposit debris and silt, while floodwater 3 or more feet deep and flowing at a velocity of 3 or more feet per second could easily sweep an adult person off his feet, causing injury or drowning. Floodwater flowing at greater velocities is capable of causing severe erosion to streambanks and fill around bridge abutments and transporting large objects. Table 6 lists velocities that would occur in the main channel and overbank areas of selected cross sections of Pike Creek during the 100-Year and 500-Year Floods.

TABLE 6

PIKE CREEK VELOCITIES

Selected Cross Sections

Location(a)	Mileage Above Mouth	Velocities			
		100-Year Flood		500-Year Flood	
		Channel ft/sec	Overbank(b) ft/sec	Channel ft/sec	Overbank(b) ft/sec
Cross Section Number					
6	1.70	11.2	3.9	13.2	5.1
9	2.81	8.3	4.0	9.8	5.2
12	3.51	6.7	3.3	7.3	4.1
18	5.47	4.4	2.8	4.2(c)	2.8

(a) See Plates 3 through 5 for locations of cross sections.
(b) Value given is maximum of left or right overbank velocity.
(c) Velocities reduced by the backwater effect of restrictive cross sections and/or bridge approach embankments.

Rates of rise and duration of flooding – Intense rainfalls that accompany severe stormfronts usually produce the floods occurring in the Pike Creek Basin. There is a time lag of several hours before overbank flooding occurs along the main stream. Floods generally rise slowly and stay out of banks for long periods of time. Table 7 gives approximately the maximum rate of rise, height of rise (from critical stage level to maximum floodflow level), time of rise (time period corresponding to height of rise), and duration of critical stage (period of time flooding is above critical stage level) for the 100-Year Flood at Cross Section No. 10.

TABLE 7

RATES OF RISE AND DURATION

100-Year Flood
Pike Creek

Flood	Mileage Above Mouth	Maximum Rate of Rise ft/hr	Height of Rise ft	Time of Rise hrs	Duration of Critical Stage hrs
Cross Section 10	3.00	0.9	4.0	8.2	15.6

Photographs, possible future flood heights – The levels that the 100-Year and 500-Year Floods are expected to reach at various locations along Pike Creek are indicated on the following photographs.

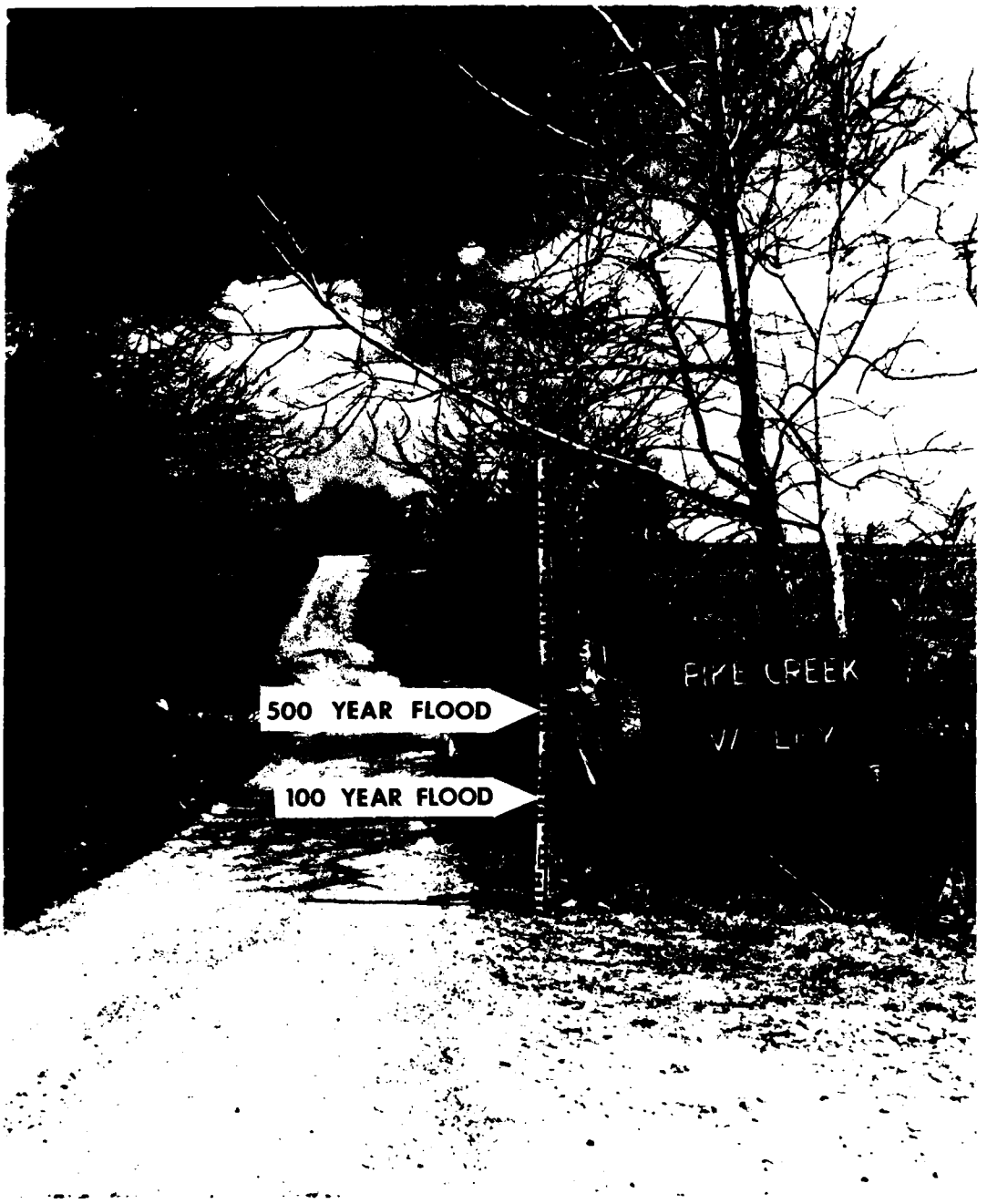


FIGURE 1 - Possible future flood heights at a Private Road Bridge (Mile 3.02) over Pike Creek.

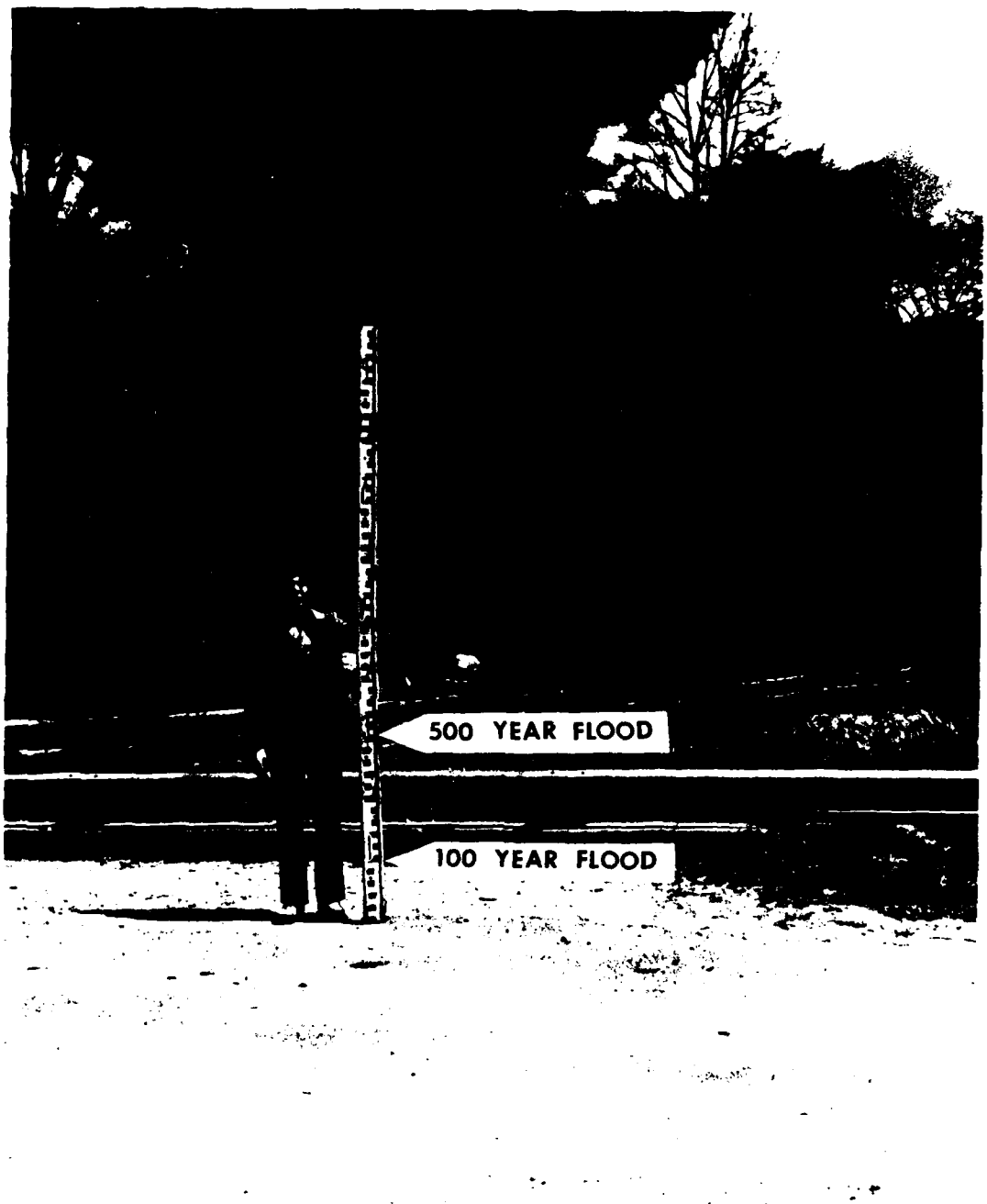


FIGURE 2 - Possible future flood heights at the Granville Road Bridge over Pike Creek.

FIGURE 3 - Possible future flood heights at the Delaware Route 72 Bridge over Pike Creek.

GLOSSARY

Backwater. The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.

Five Hundred (500) Year Flood. A flood having an average frequency of occurrence in the order of once in 500 years and a 0.2% chance of occurrence in any year.

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Plain. The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwater.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Hurricane. An intense cyclonic windstorm of tropical origin in which winds tend to spiral inward in a counterclockwise direction toward a core of low pressure, with maximum surface wind velocities that equal or exceed 75 miles per hour (65 knots) for several minutes or longer at some points. Tropical storm is the term applied if maximum winds are less than 75 miles per hour.

One Hundred (100) Year Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on the statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

Left Bank. The bank on the left side of a river, stream, or watercourse, looking downstream.

Right Bank. The bank on the right side of a river, stream, or watercourse, looking downstream.

Underclearance Elevation. The elevation at the top of the opening of a culvert, or other structure through which water may flow along a watercourse.

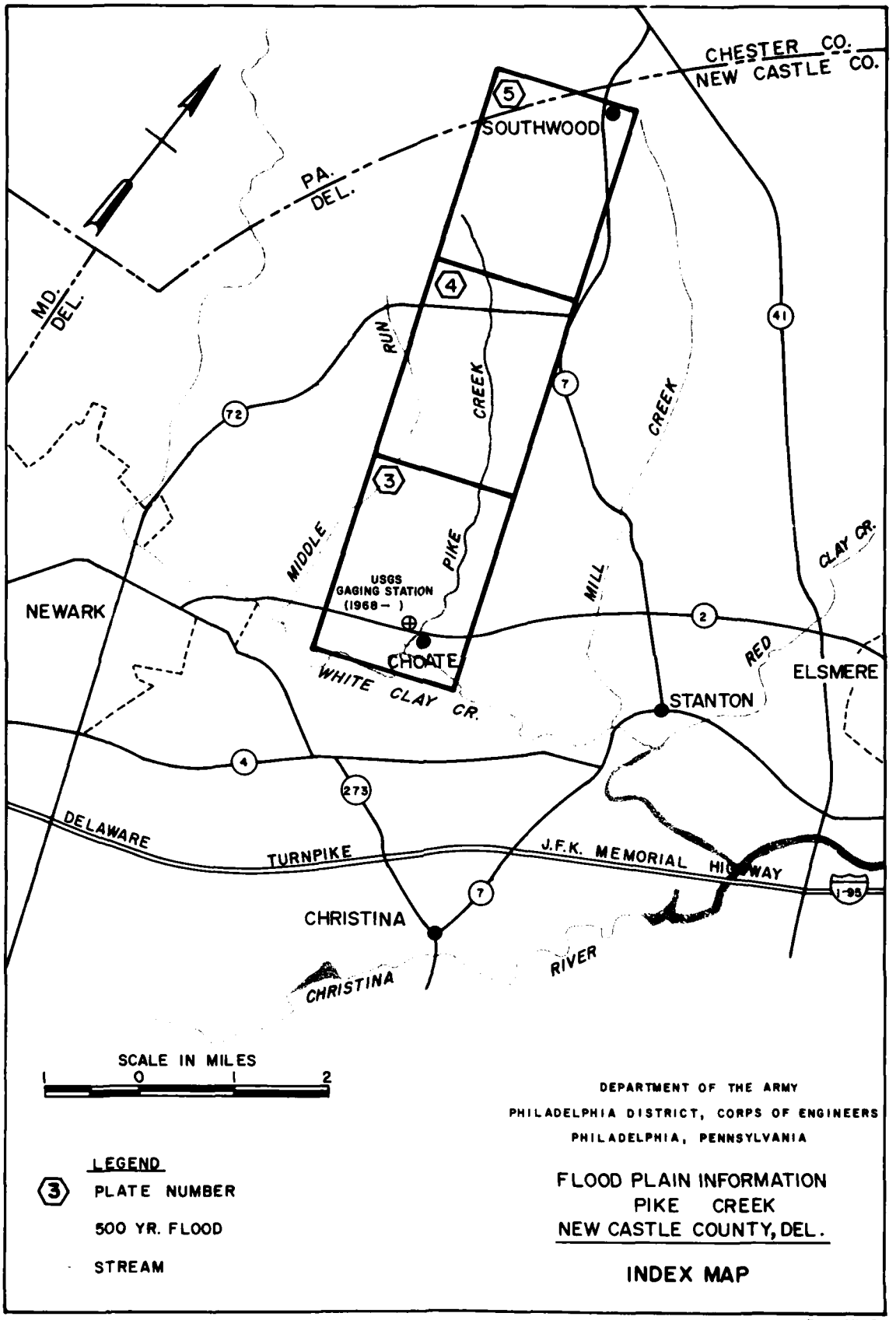
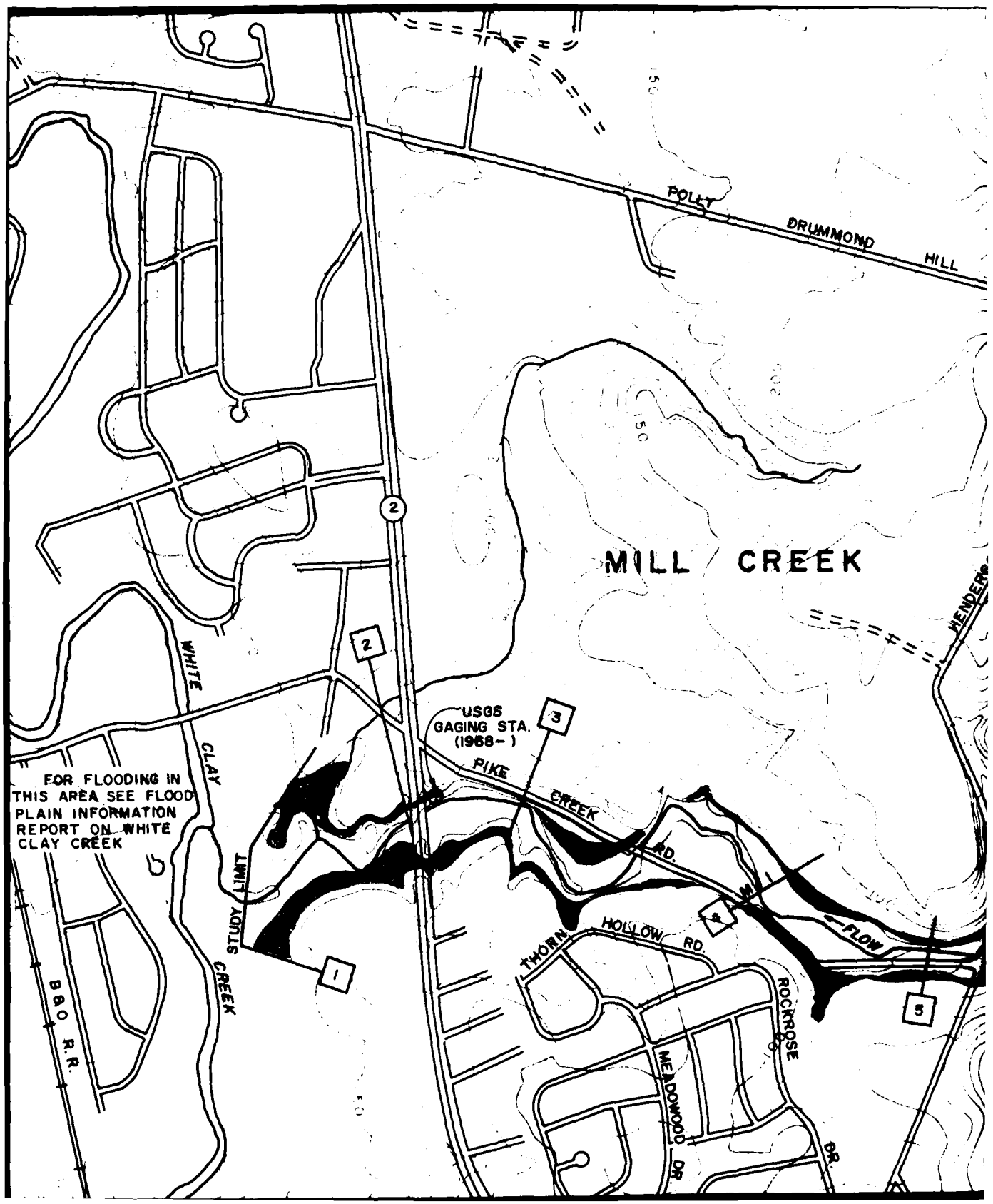
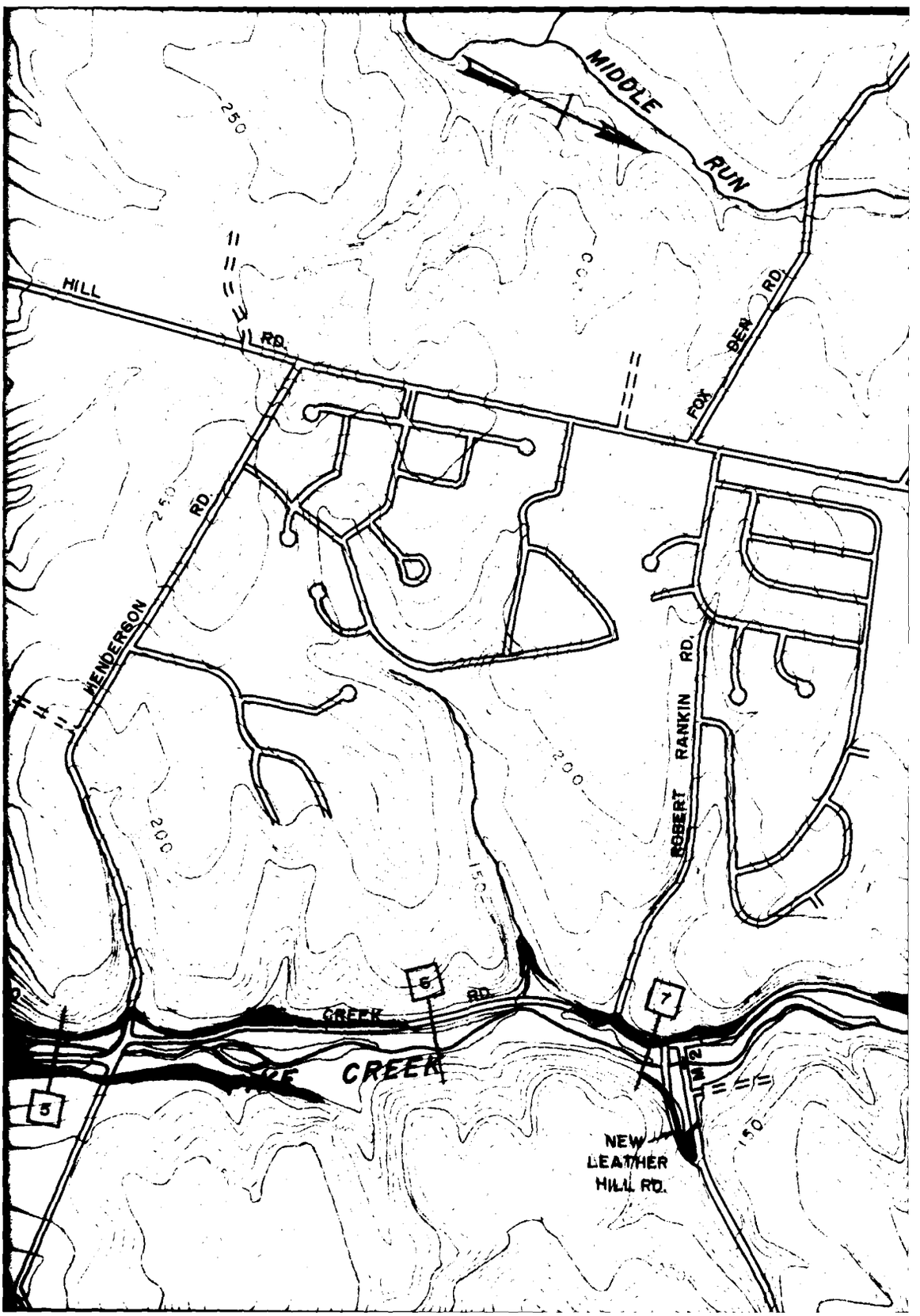

CHESTER CO.
NEW CASTLE CO.
SOUTHWOOD
PA.
DEL.
MD.
DEL.
RUN
CREEK
CREEK
MIDDLE
PIKE
MILL
CLAY CR.
USGS
GAGING STATION
(1968 –)
NEWARK
CHOATE
WHITE CLAY CR.
RED
ELSMERE
STANTON
DELAWARE
TURNPIKE
J.F.K. MEMORIAL HIGHWAY
I-95
CHRISTINA
CHRISTINA
RIVER
SCALE IN MILES
0 1 2
LEGEND
PLATE NUMBER
500 YR. FLOOD
STREAM
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA
FLOOD PLAIN INFORMATION
PIKE CREEK
NEW CASTLE COUNTY, DEL.
INDEX MAP

PLATE 2


POLLY DRUMMOND HILL
MILL CREEK
WHITE CLAY CREEK
STUDY LIMIT
USGS GAGING STA. (1968-)
PIKE CREEK RD.
THORN HOLLOW RD.
MEADOWOOD DR.
ROCKROSE DR.
FLOW
B&O R.R.
FOR FLOODING IN THIS AREA SEE FLOOD PLAIN INFORMATION REPORT ON WHITE CLAY CREEK
1
2
3
4
5


MIDDLE RUN
HILL RD.
FOX DEN RD.
HENDERSON RD.
ROBERT RANKIN RD.
NEW LEATHER HILL RD.
CREEK
RD.
250
200
150
5
6
7
M2

END

OW LIMITS

R 500 YEAR FLOOD

BOVE MOUTH

ECTION

ELEVATION IN FEET
EL DATUM

OUTE

.S. 7.5 MIN. QUADRANGLE
, DEL. 1970 & KENNETT
980.

SHOWN MAY VARY FROM
GROUND AS EXPLAINED

FLOODPLAIN MAY BE
G FROM LOCAL RUNOFF.

TERVAL IS 10 FEET.

IN FEET
800 1600

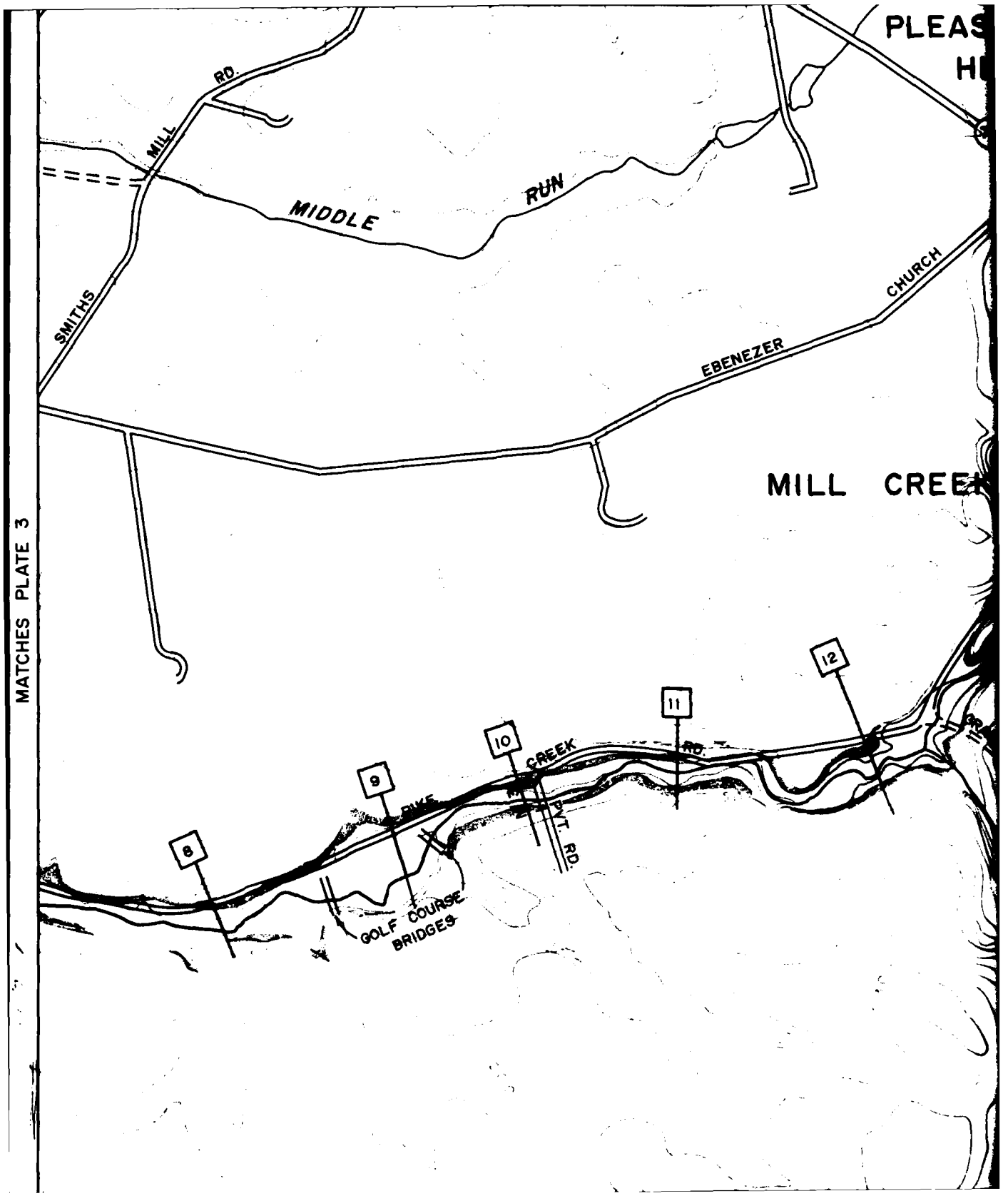
OF THE ARMY
T, CORPS OF ENGINEERS
, PENNSYLVANIA

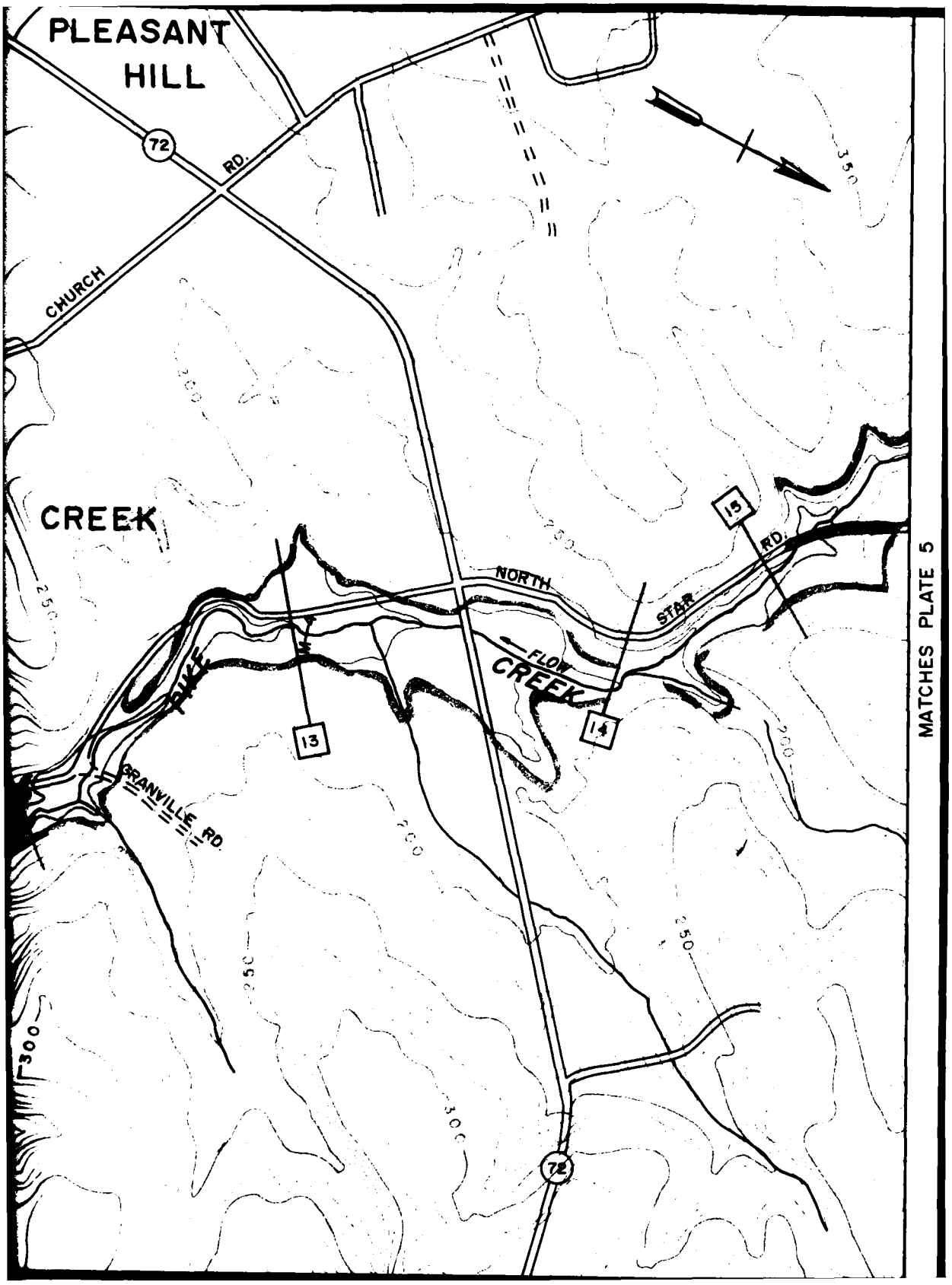
INFORMATION

CREEK
NTY, DELAWARE

D AREAS

PLATE 3


MATCHES PLATE 3
PLEAS
H
MILL
RD.
MIDDLE
RUN
SMITHS
CHURCH
EBENEZER
MILL CREE
12
11
10
9
8
CREEK
RD.
PIKE
PVT. RD.
GOLF COURSE
BRIDGES


PLEASANT HILL
72
RD.
CHURCH
CREEK
NORTH
STAR
RD.
FLOW
CREEK
DIKE
13
14
15
GRANVILLE RD.
72
350
300
250
200
MATCHES PLATE 5

EGEND

LOW LIMITS

AR
D

500 YEAR
FLOOD

ABOVE MOUTH

SECTION

ELEVATION IN FEET
VEL DATUM

ROUTE

S.S. 7.5 MIN. QUADRANGLE
, DEL. 1970 & KENNETT
1986.

SHOWN MAY VARY FROM
GROUND AS EXPLAINED

FLOODPLAIN MAY BE
NG FROM LOCAL RUNOFF.

NTERVAL IS 10 FEET.

E IN FEET

000 1600

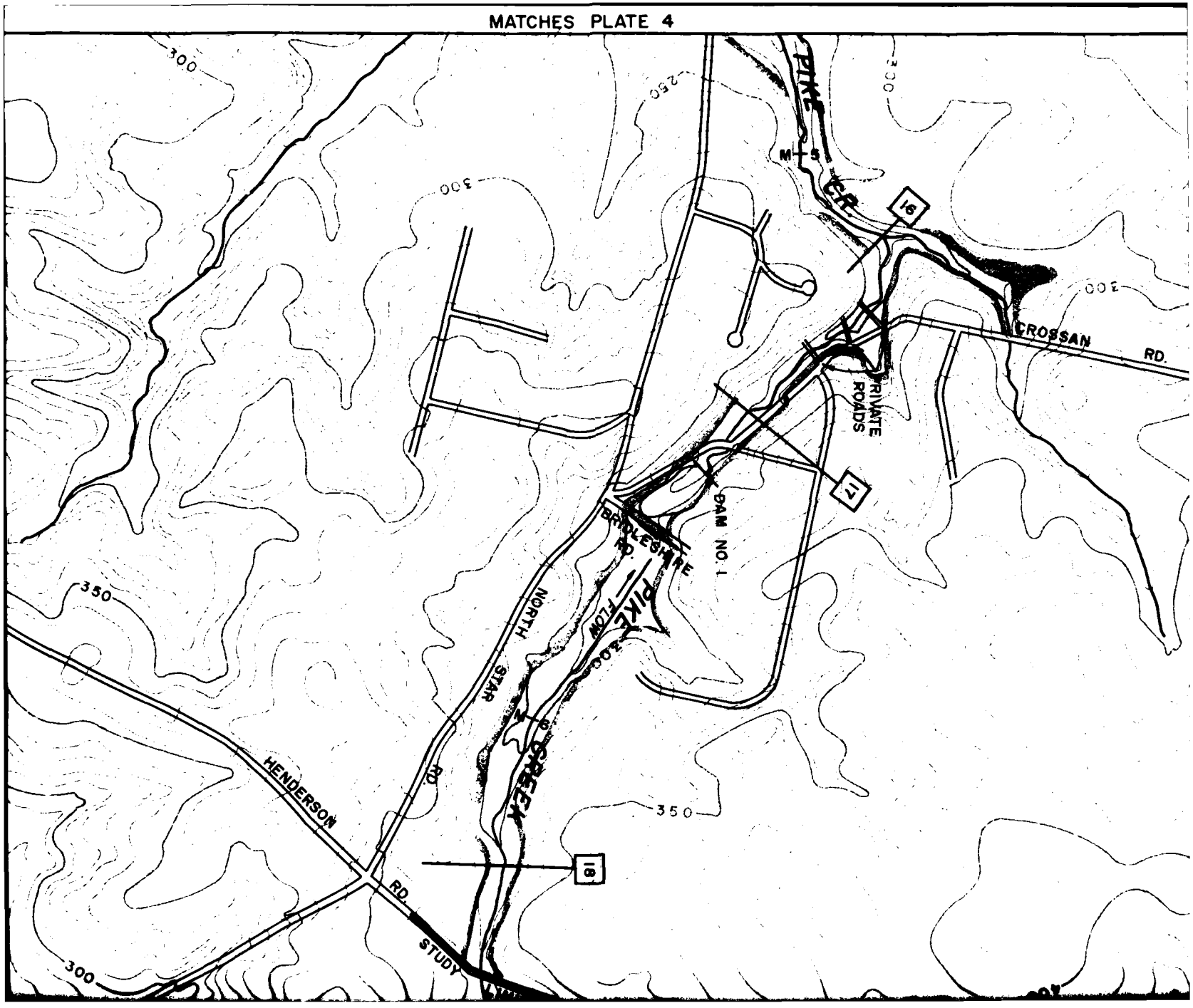
T OF THE ARMY
ST, CORPS OF ENGINEERS
A, PENNSYLVANIA

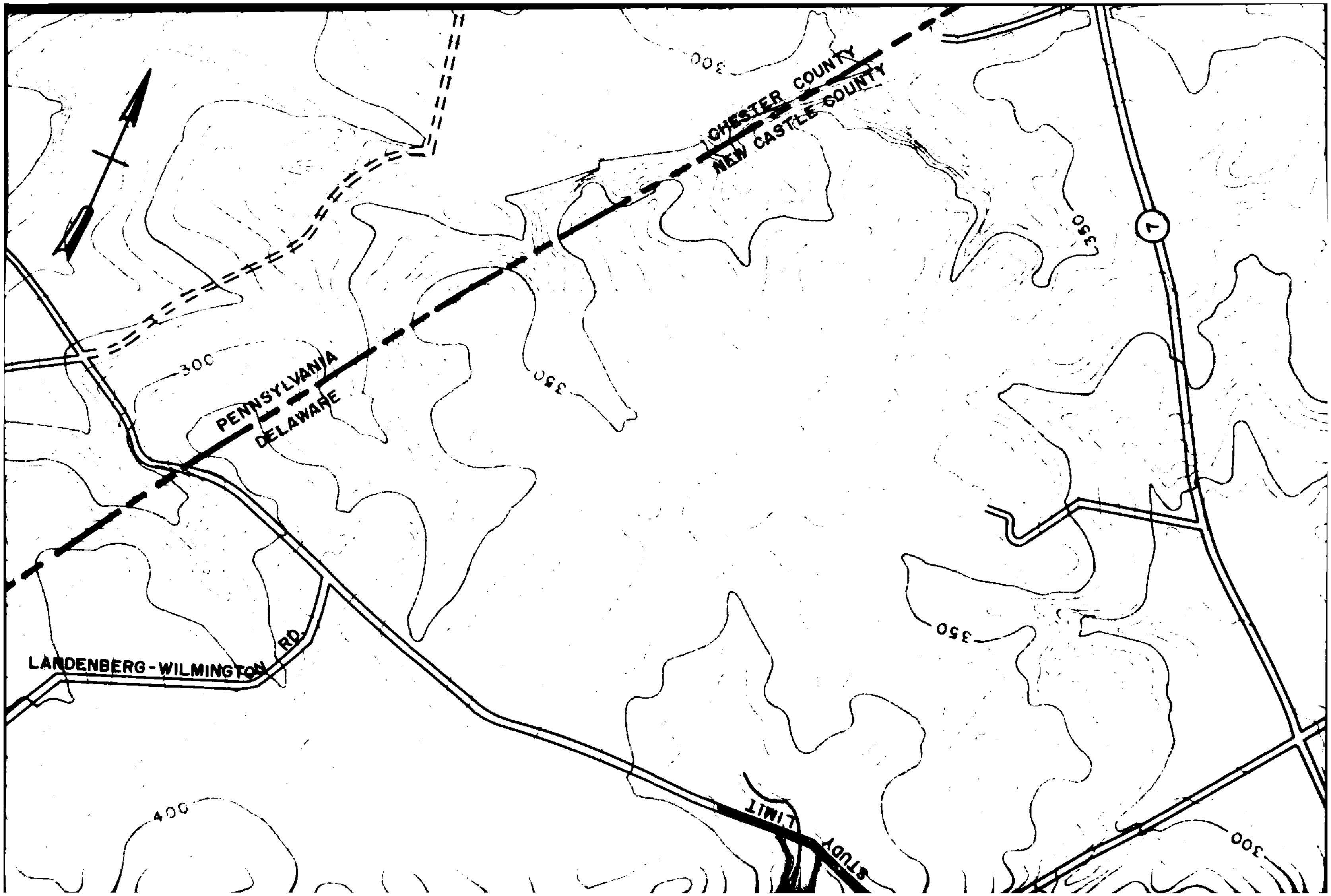
INFORMATION

CREEK
UNTY, DELAWARE

D AREAS

PLATE 4


MATCHES PLATE 4
300
250
300
PIKE
M-5
C.R.
16
300
CROSSAN
RD.
PRIVATE
ROADS
17
DAM NO. 1
BRIDLESHIRE
RD.
PIKE
FLOW
300
NORTH
STAR
CREEK
350
HENDERSON
RD.
350
STUDY
300
18



PENNSYLVANIA
DELAWARE
CHESTER COUNTY
NEW CASTLE COUNTY
LANDENBERG-WILMINGTON RD.
STUDY LIMIT
7
300
350
350
350
400
300
300

)0 YEAR
FLOOD

I

IN FEET

)IN. QUADRANGLE
)8 & KENNETT

)Y VARY FROM
)S EXPLAINED

)N MAY BE
)CAL RUNOFF.

) 10 FEET.

1000

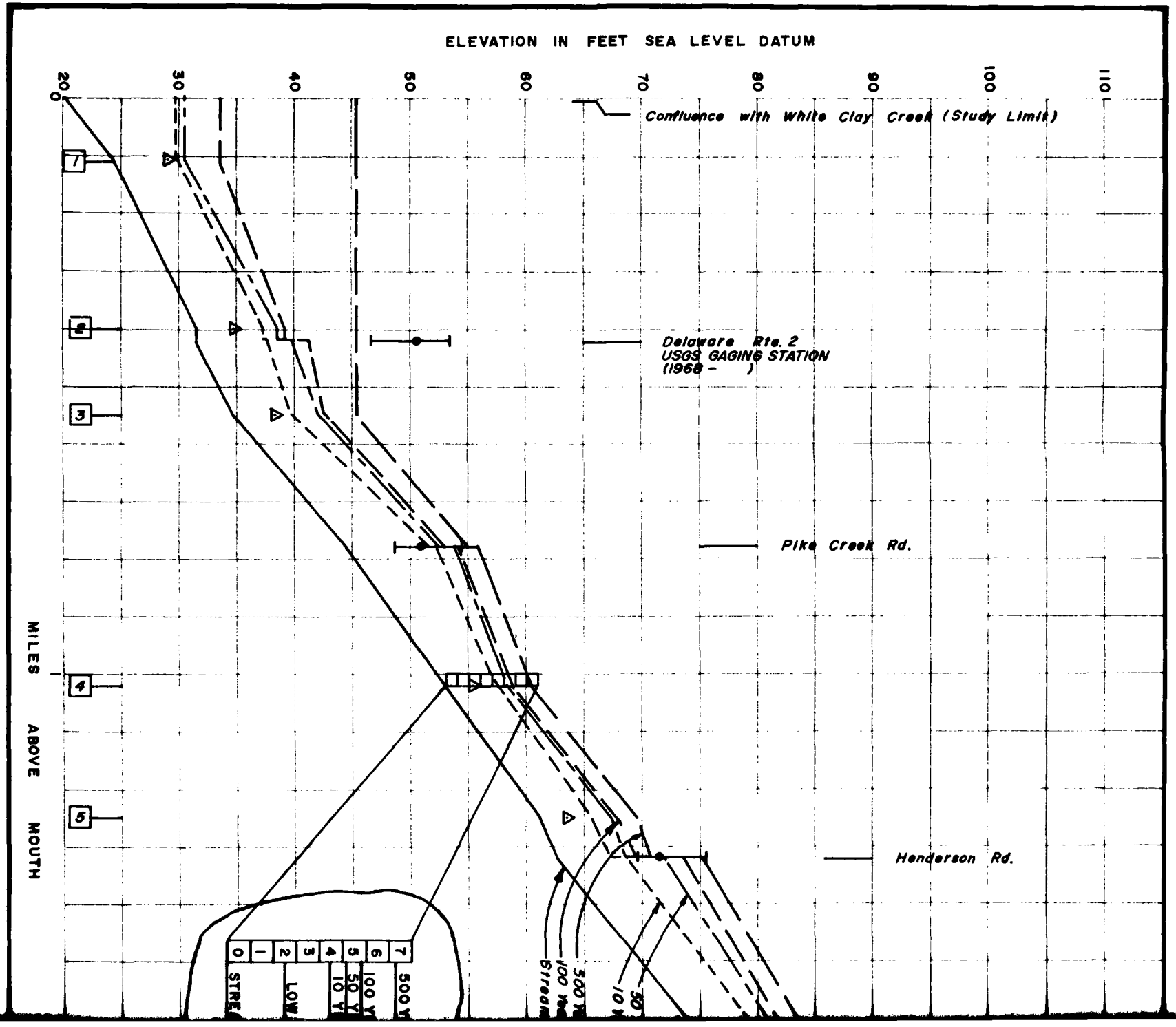
ARMY
OF ENGINEERS
LVANIA

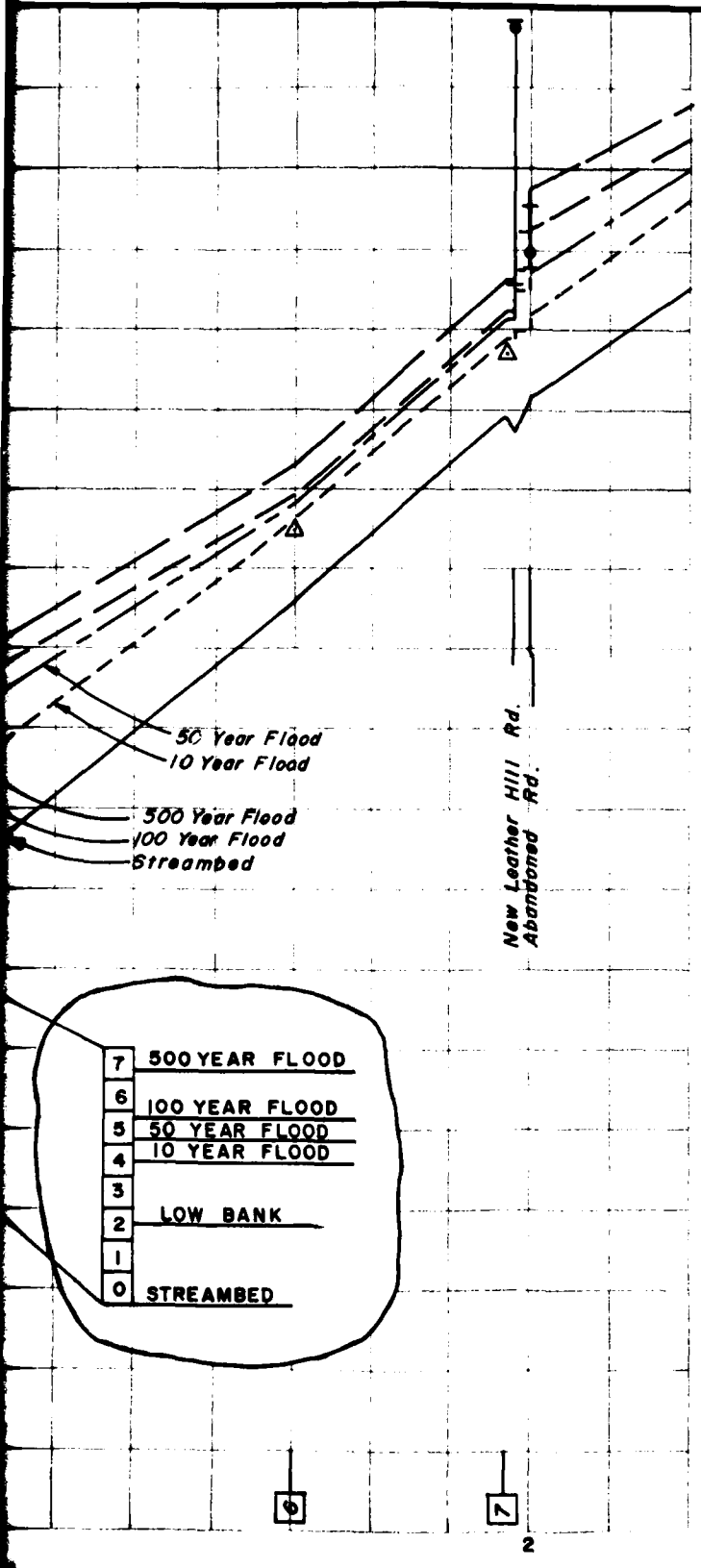
)ATION

)ELAWARE

)S

PLATE 5


ELEVATION IN FEET SEA LEVEL DATUM
20
30
40
50
60
70
80
90
100
110
Confluence with White Clay Creek (Study Limit)
Delaware Rte. 2
USGS GAGING STATION
(1968 -)
Pike Creek Rd.
Henderson Rd.
MILES ABOVE MOUTH
1
2
3
4
5
0
1
2
3
4
5
6
7
10 Y
50 Y
100 Y
500 Y



LEGEND

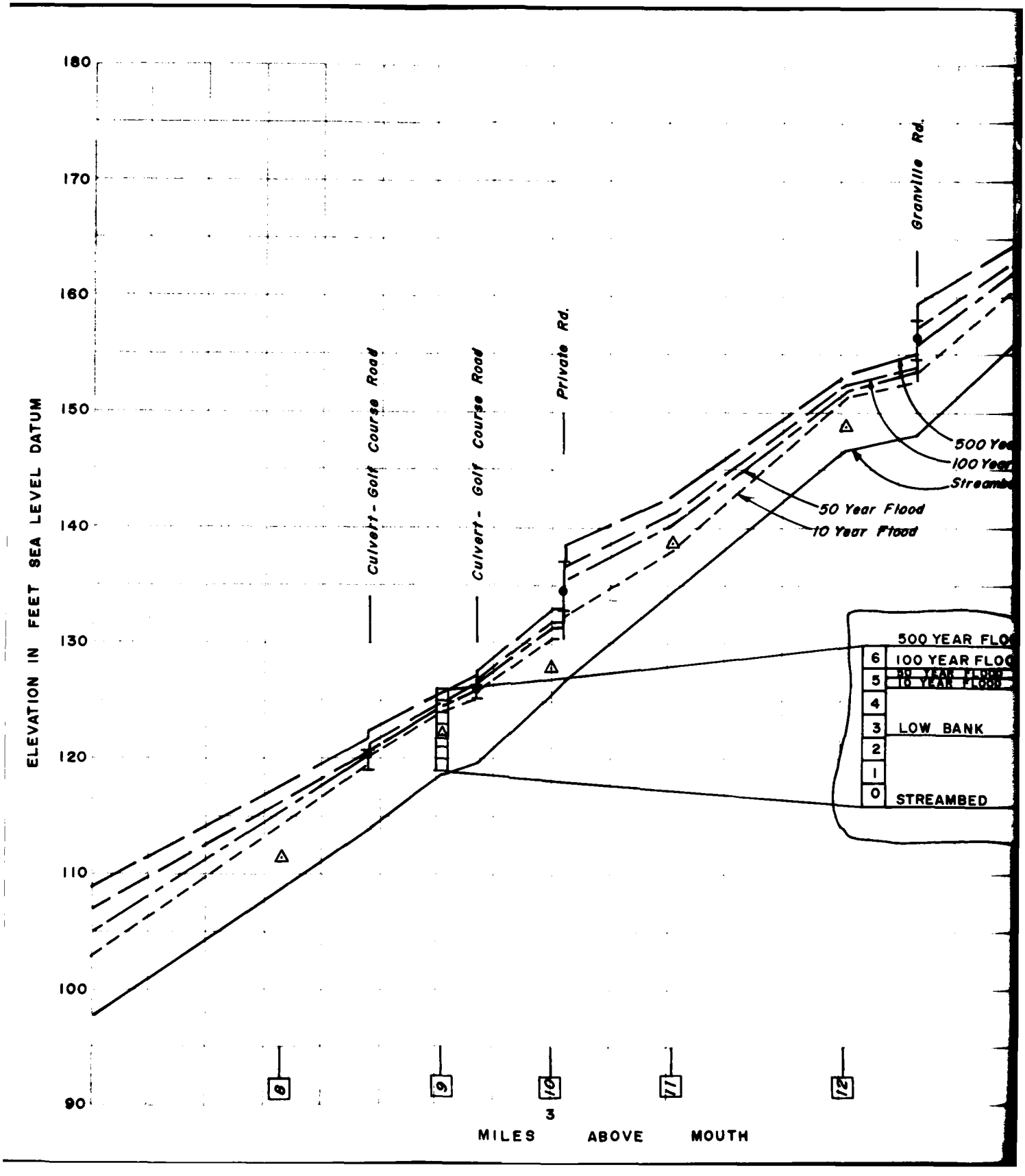
- Top of Bridge Railing
- Bridge Floor
- Underclearance
- △ Top of Low Bank
- /—Cross Section

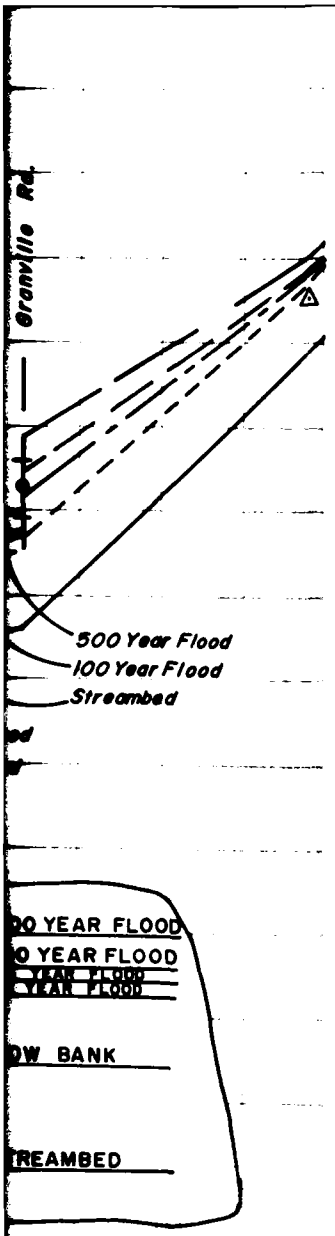
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

FLOOD PLAIN INFORMATION
PIKE CREEK
NEW CASTLE COUNTY, DEL.

HIGH WATER PROFILES
PIKE CREEK

PLATE 6


ELEVATION IN FEET SEA LEVEL DATUM
180
170
160
150
140
130
120
110
100
90
Culvert - Golf Course Road
Culvert - Golf Course Road
Private Rd.
Granville Rd.
500 Year
100 Year
Stream
50 Year Flood
10 Year Flood
500 YEAR FLO
6
100 YEAR FLOO
5
4
3
LOW BANK
2
1
0
STREAMBED
6
9
10
11
12
3
MILES ABOVE MOUTH



LEGEND

- Top of Bridge Railing
- Bridge Floor
- Underclearance
- △ Top of Low Bank
- [8] Cross Section

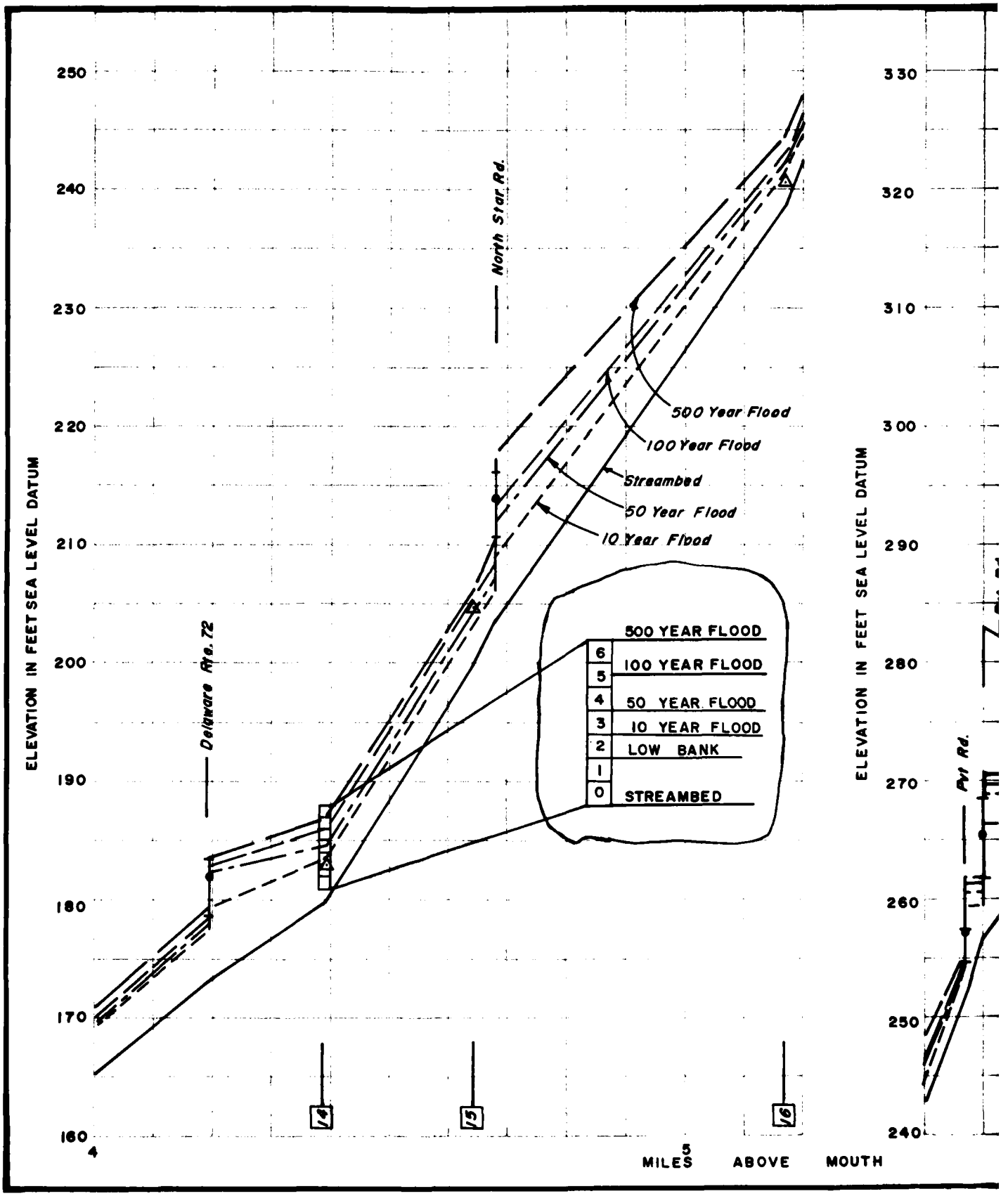
[13]

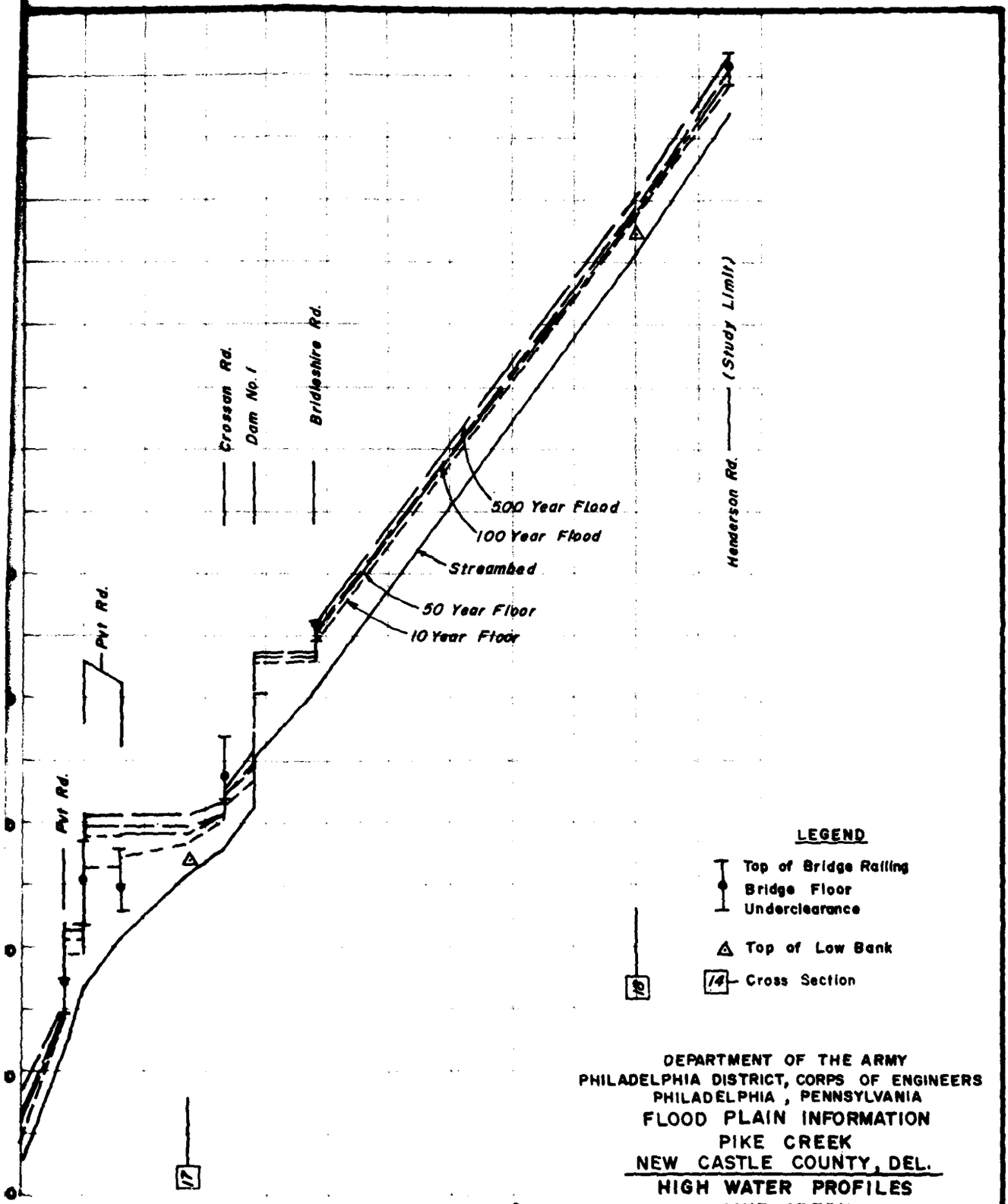
4

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

FLOOD PLAIN INFORMATION
PIKE CREEK
NEW CASTLE COUNTY, DEL.

HIGH WATER PROFILES
PIKE CREEK


ELEVATION IN FEET SEA LEVEL DATUM
250
240
230
220
210
200
190
180
170
160
North Star Rd.
Delaware Rte. 72
500 Year Flood
100 Year Flood
Streambed
50 Year Flood
10 Year Flood
500 YEAR FLOOD
6
100 YEAR FLOOD
5
4
50 YEAR FLOOD
3
10 YEAR FLOOD
2
LOW BANK
1
0
STREAMBED
14
15
16
4
5
MILES ABOVE MOUTH
ELEVATION IN FEET SEA LEVEL DATUM
330
320
310
300
290
280
270
260
250
240
Pyl Rd.

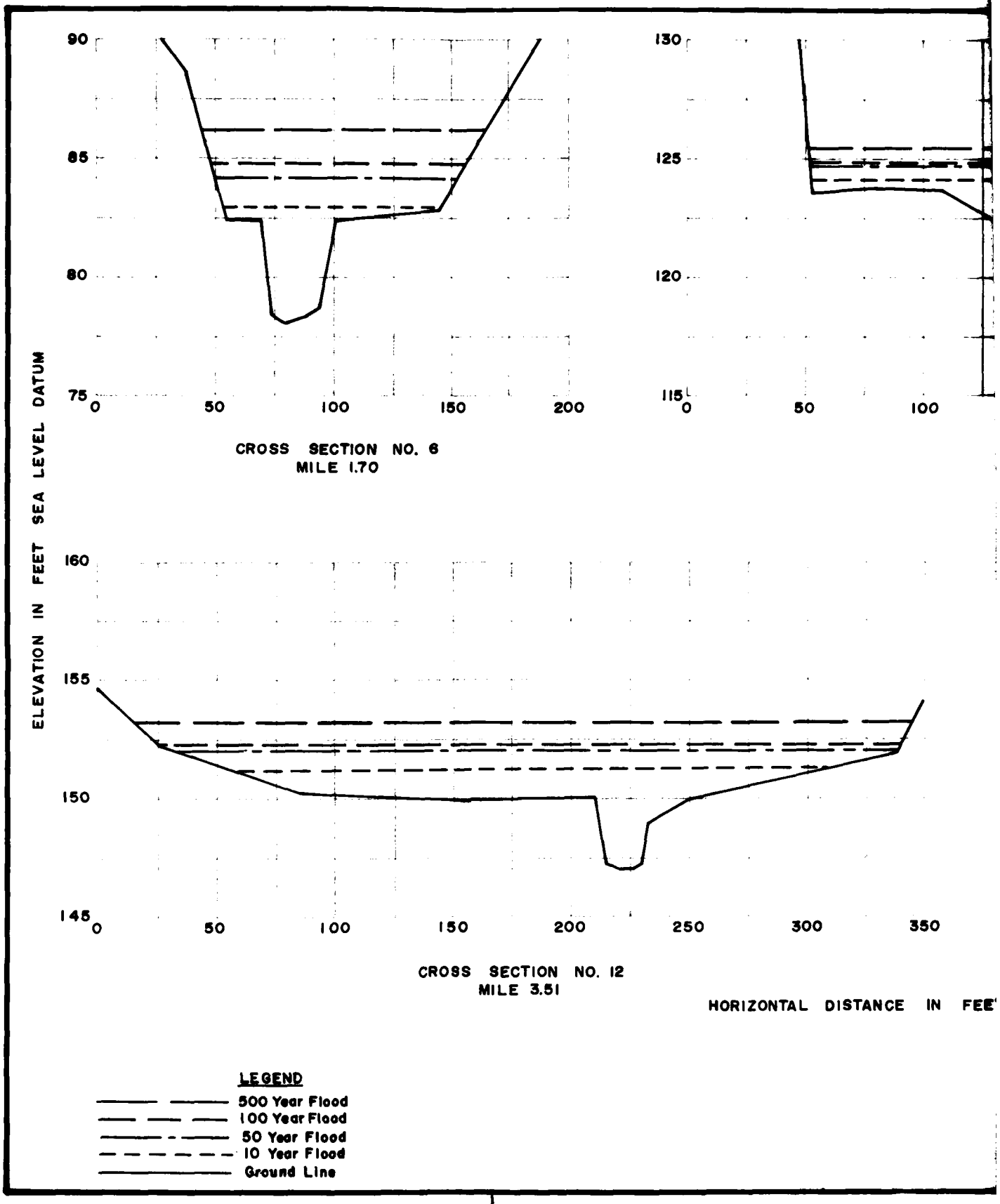


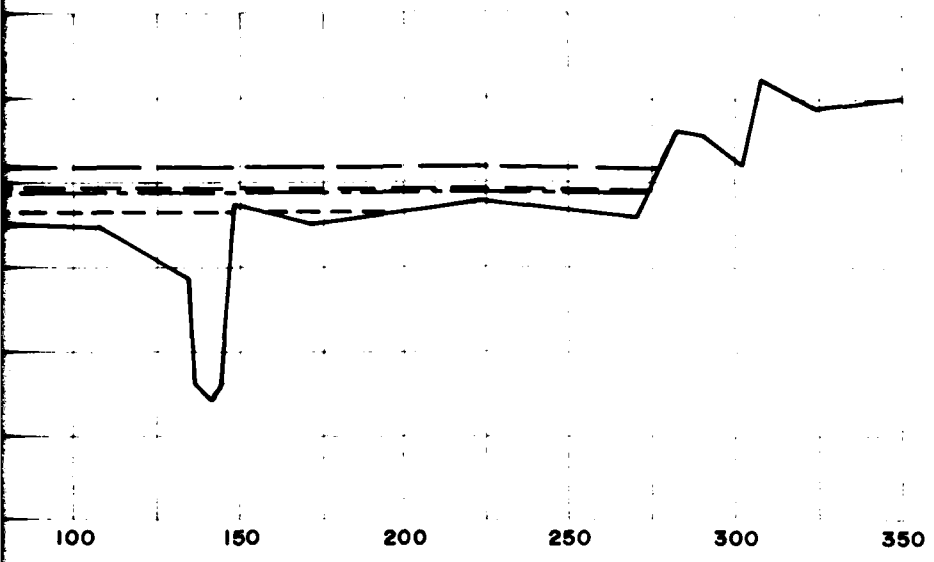
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

FLOOD PLAIN INFORMATION
PIKE CREEK
NEW CASTLE COUNTY, DEL.

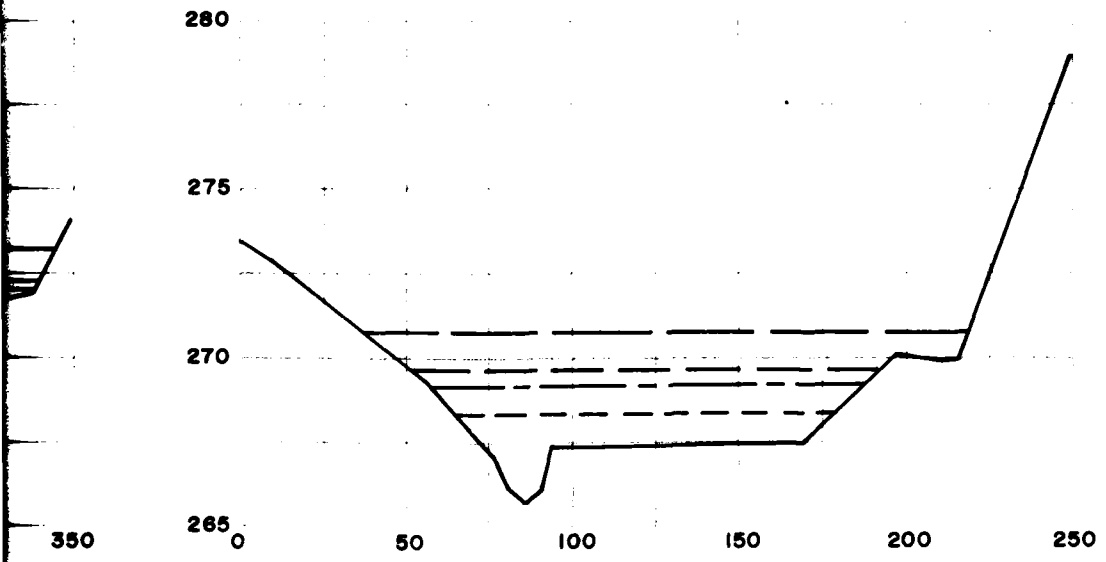
HIGH WATER PROFILES
PIKE CREEK

PLATE 8


90
85
80
75
0
50
100
150
200
130
125
120
115
0
50
100
ELEVATION IN FEET SEA LEVEL DATUM
CROSS SECTION NO. 6
MILE 1.70
160
155
150
145
0
50
100
150
200
250
300
350
CROSS SECTION NO. 12
MILE 3.51
HORIZONTAL DISTANCE IN FEE
LEGEND
500 Year Flood
100 Year Flood
50 Year Flood
10 Year Flood
Ground Line



CROSS SECTION NO. 9
MILE 2.81



CROSS SECTION NO. 17
MILE 5.47

CE IN FEET

NOTES:

1. The fourteen cross sections on Pike Creek not shown in this report are on file at the Philadelphia District Corps of Engineers and are available for inspection upon request.
2. Cross sections taken looking downstream.

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

FLOOD PLAIN INFORMATION
PIKE CREEK
NEW CASTLE COUNTY, DEL.

SELECTED CROSS SECTIONS
PIKE CREEK

PLATE 9